for which Texas is famous—blew steadily all night, the early flying hours were just as rough as those at noonday. When I first found the rough flying so early in the morning I was much concerned and sought everywhere for a reason. I think an officer told me it was due to the wind blowing all night. I watched it thereafter and found it to be a fact.

I feel that none of the boys have exaggerated when they told you of the great drops and lifts they have gotten from "bumps." While my greatest lift or fall would not exceed 1,500 feet I know of much greater.

DISCUSSION.

The bumpiness of a wind that has blown all night seems to be owing to the turbulence induced in the wind as it goes over the uneven ground. In much of Texas the unevennesses of scattered woods and occasional valleys would be enough to produce the effect observed. The turbulence created in this way gradually reaches to greater and greater heights: thus the wind that has blown all night may be turbulent through a layer of perhaps 1,000 to 3,000 feet.—*C. F. Brooks.*

AERIAL CONDITIONS IN AFRICA.

Some notes on the use of the aeroplane in African exploration by Lieut. L. Walmsley in the *Geographical Journal* for November (vol. liv., No. 5) are valuable in giving the results of experience. Mr. Walmsley points out that "air pockets" are normally encountered during the daytime in tropical Africa up to a height of about 6,000 feet. As a result he had to do his aerial photography in East Africa in the morning and evening, when the light was not favorable. Above 7,000 feet, however, he thinks that operations could be carried out all day long.—*Nature (London), Dec. 11, 1919, p. 379.*

An Airman's Experience in East Africa.—There is much of interest to meteorologists in the articles by Leo Walmsley entitled, "An Airman's Experiences in East Africa," which have appeared in *Blackwood's Magazine* (November and December, 1919).

The author, who served as an aeroplane observer during the war, gives a vivid account of his experiences. The dangers due to the "bumpiness" of the air were frequently serious. In the "most terrific bump of all" "the machine dropped like a stone 200 feet at least, and at such a rate that my field glasses were whipped off my shoulder and were caught in the rigging, two or three yards behind. The pilot's glasses held by the strap on his flying cap, and for two seconds they were suspended in the air above his head." Other adventures included flying through clouds almost into the flank of a mountain and reconnaissance carried out whilst surrounded by thunderstorms on all sides.—*Meteorological Office Circ. 43, Jan. 6, 1920, p. 2.*

Over Egypt and the Sudan.[1]—The desert is the playground of the winds. The wind builds up hills and lays them flat. It blows now hither, now thither. Here it lifts up the sand in great clouds that darken the sun. There it pours down the blessed rain. And the sand drinks up the rain, and laughs. That is how we found the desert in our first two days' flight. * * *

Heavy rain and a bad wind kept us at Heliopolis until 9:18 a. m., February 23. We then got away, intending to make Assuan in the day. Soon after starting we had trouble with the port-engine petrol pump. * * *

[1] From an article on "Cairo—Cape Flights: Why they failed," by Maj. C. C. Turner.

We saw little blue sky; and soon the sun was almost completely obscured by mist. About noon a sandstorm was seen away on our port bow, and very menacing it looked. Indeed, neither the desert nor the sky had a smile for us that day. The sandstorm whipped the surface of the desert almost white, the foam of this waterless ocean, and it swept on, an ugly gray-brown cloud that must be hell for anyone in it. Sandstorms are things to be avoided by aeroplanes; they would strip struts and wings and propellers. Rain is bad enough, as we were soon to know. It frayed the cutting edges of our propellers, making many bad patches which had to be repaired and repainted at the first landing.

The rain got worse, and made visibility poor. We were looking for Assiut, and at the very time we were nearly due we were over a place that tallied with it by our map. We landed at 1:15 on the sand close to the houses, and immediately a picturesque crowd of men and boys came running toward us. * * *

On the following morning it was raining, after a curiously warm night. We had slept the sleep of tired dogs in our sleeping bags on the sand of our host's tent. Owing to the delays caused by the weather and the distance of supplies we did not get away from Assiut till 10:45, which meant flying through the hottest hours of the day, and we were very soon to know what the sun can do. The wind, however, was in our favor to the extent of about 18 miles per hour, and we had strong hopes of making Wady Halfa in one flight. We got away in grand style. * * *

The sky rapidly cleared, and before long there was scarcely a cloud to be seen. But that was after a bad patch of rough work for the pilot when the machine, under lumps of heavy clouds, seemed reluctant to keep altitude. There was a time when it looked as if we were in for a return of the previous day's trouble.

Flying at a height of 5,000 and 6,000 feet under these skies, and with 10,000 square miles of desert spread out below, was extraordinarily impressive. But even under a pure blue sky the desert looks terrible. At one part of that day's flight nothing was visible but the desert, although to the expert eye a faint thin line hugging the horizon on one side might have revealed the valley of the river. * * *.—*Aeronautics (London), Mar. 25, 1920, p. 253.*

SOUTHERLY WINDS AT HIGH ALTITUDES OVER LANSING, MICH., DURING SLEET STORMS OF JANUARY, 1920.

By C. G. Andrus.

[Weather Bureau, Lansing, Mich., July 9, 1920.]

In studying Mr. C. LeRoy Meisinger's paper on "The Precipitation of Sleet and the Formation of Glaze in the Eastern United States, January 20 to 25, 1920," which appeared in the February number of the Monthly Weather Review, 1920, pages 73–80, I found in our local pilot-balloon records two items which Mr. Meisinger did not possess at the time of writing the paper.

The first of these is pertinent to his discussion (p. 76, column 2) of the wind boundary and cloud forming levels above this meridian, and is in the form of a note on the pilot-balloon ascension report at 7 a. m., January 21, 1920. This note refers to the 5/10 alto-stratus cloud covering observed at that time and reads: "White striations of alto-stratus filaments north to south, but moving rapidly from west." This seems to me to be a clear indication that the clouds formed from vapor thrust into the westerly current by another current from the south. I think this was one of the occasions when this cross-hatched effect was very noticeable.

The other item is the finding of the balloon identifying tag, attached to the balloon released here at 3 p. m., January 21, 1920. It was found late in April, 185 kilometers from Lansing, along azimuth 80° (East 10° north), at a point 5 miles northeast of Port Lambton, Ontario. This balloon was observed up to an altitude of 6 kilometers, during which altitude a westerly gale without southerly component was found. From the time it was lost to view at 31 kilometers distance until it landed at Port Lambton it pursued a course averaging 78 degrees, part of which contains the north component which existed over this part of the country in the lowest 2-kilometer layers of the atmosphere. Therefore, the wind, during a large part of the voyage to Port Lambton, must have been from a nearly southwest direction at a high rate of speed, indicating a large southerly component of velocity.

While there is nothing definite at hand concerning the altitude where the southerly component prevailed, it is of interest to know that it existed somewhere above the 6-kilometer level of the air.

Both of these items are in accord with the conclusions which were arrived at in the discussions of sleet and glaze.

THE STRUCTURE OF THE ATMOSPHERE WHEN RAIN IS FALLING.

By V. BJERKNES.

[Abstracted from Quart. Jour. Roy. Meteorological Soc., April, 1920. No. 194, 46: 119-138, disc. 138-140, 17 figs.]

In this lecture before the Royal Meteorological Society Prof. Bjerknes presented later developments of study by H. Solberg and J. B. Bjerknes under his direction, arising from the Scandinavian weather begun in the interests of daily detailed local forecasting in Norway, in the summer of 1918. Earlier Bjerknes papers (this REVIEW, Feb., 1919, **47**:90–99) made clear the nature of wind circulation in cyclones and the cause of the distribution of rainfall as it was. Cold air already in the region, when attacked on the flank by relatively warm air is overridden by the latter and a moving rain-stripe 150–300 km. wide is formed by the consequent precipitation. Associated with this rain-stripe and at another angle to it is a narrow stripe of intense rainfall marking the line where cold air underthrusts the western flank of the warm current. (See fig. 1.) The former is called the steering-line and the latter is the well-known squall-line. In this new paper the conditions in some specific cases are carefully described and the magnitude of the operation estimated. The rainfall ordinarily occurring in the belt immediately east or north of the steering-line is said to represent 1,000 million H. P., or the equivalent of a waterfall equal to fifteen Niagaras.

The concluding paragraph of his discussion of the moving cyclone is worth quoting:

> The appearance of the sky in the different parts of a cyclone, at different distances from its center and in different situations relative to the steering and squall-lines, is so characteristic, and develops in so typical a way during the passage of the whole system, that it will always be recognized when one has once become acquainted with it. Of course the formation of clouds and rain of local topographical origin may change the picture, but not in general beyond recognition, and these local changes of the picture should be studied carefully at every place. When this is done, observation of the phenomena of the sky will be seen to have an importance equal to the study of the weather chart, especially for short-range forecasts. The time should be past when weather forecasts are made as bureau work in an office from which only a narrow strip of the sky is seen.

A distinctly new contribution to local forecasting is brought out in his description and explanation of the distribution of local thunderstorms in Norway in a selected 6-day period in summer. The showers developed by day only where solar winds (i. e. sea breezes and valley winds) converged, but not all such points of convergence had showers on the first, second, or even third day. It was found that not till moist air arrived from the sea was it possible for showers to develop over inland convergence points. The divergence points were, of course, over glaciers, fiords, and large lakes, and hence these and their surroundings remained dry on account of descending air.

FIG. 1.—Distribution of cloudiness and precipitation in a moving cyclone.

After the third day, however, nocturnal rains began to occur over such valley areas, for the cold mountain breezes at night smoothly underran and lifted the relatively warm, moist air over thse bodies of water and their shores.

Rains in cyclones and such local showers are due to new air and to overrunning, up-thrust, or local heat convection.

For greatest success the forecaster should find the region of convection, using stream-line charts, and by observation of humidity and other factors follow the advancing front of new air. With such information, detailed forecasts are now being made as to when and where precipitation will occur, and the method seems to hold the possibility of foretelling how much will fall as well.—*C. F. B.*